

# STEAM TO HOT WATER BOILER RETROFIT DESIGN-BID-BUILD PROJECT

This month's B2B will focus on the retrofit of a 1960s-era, 250,000-sq-ft hospital conversion to apartments, changing out the high-pressure steam boilers to hot water boiler modules. The existing steam system had a pressure-reducing station taking the steam from high pressure to medium pressure down to low-pressure steam that served multiple steam-to-hot water heat exchangers, which in turn served the building heating system.

The energy retrofit portion of the building program is to furnish and install a series of high efficient, hot water condensing boilers and remove the steam-to-hot water heat exchangers and condensate pump and receiver sets. The real estate investor/owner shall hire an owner representative along with a third-party testing, adjusting, and balancing (TAB) consultant and third-party commissioning consultant. The design team shall include the HVAC design engineer as the prime consultant with architectural, structural, plumbing, electrical, and estimating consultants.

The building's facility manager and the consulting HVAC engineer will review the *2015 ASHRAE Handbook — HVAC Applications*, chapter 1 (Residences). The design engineer is directed to *2016 ASHRAE Handbook — HVAC Systems and Equipment* and, more specifically, chapters 1 (HVAC System Analysis and Selection) and 32 (Boilers). It is also recommended that the design team and the owner's team review *2015 ASHRAE Handbook — Building Operation and Maintenance*, chapters 36 through 43 and chapter 59 (HVAC Security).

Project delivery method shall be design-bid-build (DBB). The building's facility manager will provide her own operating and maintenance staff assistance to the general contractor's subcontractors and boiler equipment manufacturer's technician at project startup. For this month's equipment selection, six modular condensing boilers will serve the existing 2-pipe perimeter heating system. Each boiler unit shall be 360 MBH output, 95% thermal efficiency, Energy Star-compliant, natural gas, and capable of modulating down to 20% of rate input. Hot water shall be 160°F HWS and 130°F HWR at peak heating and 110°F HWS and 80°F HWR at low load. The boilers shall be furnished and installed with gas trains, 4-in pressure, and required gas relief vents. A new boiler room ventilation fan shall be variable speed blower system to maintain a positive pressure within the room. This combustion makeup air design shall be via direct outdoor duct terminating at each boiler. The boilers themselves shall be BACnet controls with 24 VAC control circuit and control panel, temperature and pressure gages, temperature sensors (HWS, HWR, flue, and outdoor air), and low water flow protection. A water pressure relief valve will be piped to funnel floor drain adjacent to each boiler. Each boiler's controls shall be capable of variable speed pumping to maintain constant Delta T and to stage on and off of units. Boiler venting shall be sidewall and not exceed 24 ft in length.

Hot water pumping shall have in-line circulators at each boiler. Primary pumps shall be new vertical, floor-mounted type with VFD motors and configured for lead-lag automatic control sequence. Each boiler shall be piped to include shutoff valves, inlet strainer with

blow-off valve, 2-position ATC valve, circulator, and balancing valve for fine-tuning flow. One pressure gage shall be used with individual connection and associated petcocks at inlet and outlet of strainer, inlet and outlet of pump, and immediately after balancing valve. A manual air separator shall be located at each boiler, along with an in-line separator and automatic water makeup connection located between the boilers and the primary pumps. There will be one city water backflow preventer to serve the entire heating system.

The boiler-furnished automatic controls shall be a computerized system utilizing wireless technology integrated with the building's controls. This system will also interface with the building's security system managed by the owner's security subcontractor.

Electrical shall be 480/3/60 for .5 hp and larger and 120/1/60 for motors less than .5 hp. The HVAC subcontractor's ATC subcontractor and electrical subcontractor shall work together to interface the new boiler controls with the building's new automation system.

The design team, along with the owner's input, shall produce conceptual drawings, basis of design (BoFD), design development (DD) drawings and specifications, and contract documents (CD) in sync with the commissioning consultant's commissioning plan.

The water balancing consultant's TAB plan shall be coordinated with the HVAC design engineer to work in sync to produce an as-built hydraulic model of the entire hot water system to assure continuous system performance and to also assure the peak pumping performance. The facility manager shall have her O&M personnel review the documents throughout the design phase and receive introduction training of the new equipment. This staff shall observe equipment startup, DBB contractor and subcontractors' punchlist, and the commissioning system demonstration. When system is ready, the 3rd-party commissioning engineer shall observe the heating system performance using functional performance test narratives.

## **The DBB contractor shall include the following during the shop drawing submittal phase:**

- Equipment submittals - Startup sheet - Troubleshooting sheets - O&M manuals, parts, and lubricants - ATC submittal, including integrating boiler manufacturer's furnished ATC into an integrated/complete overall ATC submittal.

## **The 3rd-party TAB firm shall complete the following:**

- TAB system flow diagram of entire hot water system, with gpm and pumps head indicated as each boiler is sequenced on (maximum of six boilers on) each piece of new and existing perimeter heating equipment.
- TAB system flow diagram update of entire supply and return water system, drawing upon data from the hydraulic model with gpm and pressure drop at each piece of equipment and at major branch runouts.

Refer to The Facility Files for additional information pertaining to completing the B2B test. **ES**



The design engineer shall check off the boxes from the list of company's standardized field observation checklists below that he will need to upload on to his tablet computer prior to heading out to the construction site to complete his final HVAC inspection and punchlist. These checklists will be touchscreen type. When the engineer returns to the office or he sends the completed checklists via the

internet to the office, the completed checklists shall be automatically downloaded to the company's computer server and placed in the job folder's "Project Closeout" section of the folder. The completed checklists, along with associated digital photographs taken at the time of the field visit, will automatically be electronically sent to the following individuals and departments.

**TEAM CORRESPONDENCE DIRECTORY CHECKLIST**

*(Check the appropriate boxes)*

- Project Engineer  Owner Representative  IPD Manager
- Construction Manager  General Contractor  Design-Build Contractor  Facility Manager  HVAC Subcontractor
- ATC Subcontractor  State Energy Department  ASHRAE
- Piping Subcontractor  Sheet Metal Subcontractor
- 3rd-Party Cx Consultant  3rd-Party TAB Consultant
- Equipment Manufacturers  Building Inspector
- Others: (insert list) \_\_\_\_\_

**HVAC CONTRACT SPECIFICATION CHECKLIST**

- Division 1 Project Closeout  Data Center Process Equipment
- Owner Furnished Equipment  Structural  Electrical
- Plumbing  Fire Protection  HVAC  Infection Control
- ATC  Boilers  Pumps  Chillers  Fans  Air Handlers
- Terminal Units  Piping System  Sheet Metal System
- TAB  Commissioning  Others: \_\_\_\_\_

**HVAC CONTRACT DRAWING INSTALLATION CHECKLIST**

- Process Equipment  Owner Furnished Equipment  Structural
- Electrical  Plumbing  Fire Protection  HVAC  Infection Control  ATC  Boilers  Pumps  Chillers  Fans  Air Handlers  Terminal Units  Piping System  Sheet Metal System
- Equipment Room  Tel-Data  Others: \_\_\_\_\_

**HVAC STARTUP CHECKLIST**

- Process Equipment  Owner Furnished Equipment  Structural
- Electrical  Plumbing  Fire Protection  HVAC  Infection Control  ATC  Boilers  Pumps  Chillers  Fans  Air Handlers  Terminal Units  Piping System  Sheet Metal System
- Equipment Room  Tel-Data  Others: \_\_\_\_\_

**COMMISSIONING FPT (Functional Performance Test)**

- Process Equipment  Owner Furnished Equipment
- Structural  Electrical  Plumbing  Fire Protection
- HVAC System  Infection Control  ATC  Boilers  Pumps
- Chillers  Fans  Air Handlers  Terminal Units  Piping System  Sheet Metal System  Equipment Room  Tel-Data
- Others: \_\_\_\_\_